



# United States Department of the Interior

FISH AND WILDLIFE SERVICE  
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Vicksburg, Mississippi 39180-5269

September 3, 1999

Colonel Robert Crear  
Vicksburg District Commander  
U.S. Army Corps of Engineers  
4155 Clay Street  
Vicksburg, Mississippi 39180-3435

Dear Colonel Crear:

Enclosed is a Planning-Aid Report (PAR) related to the ongoing Yazoo Backwater Area Project post-authorization re-evaluation study. During a February 23, 1999, meeting at the Mississippi Valley Division and at subsequent meetings with your staff regarding that study, we advised that the Service does not concur with the District's forecast that existing conditions will remain constant throughout the future without-project. We also indicated that, in accordance with guidance contained in the Water Resource Council's *Economic and Environmental Principles and Guidelines for Water and Related Land Resources*, we would provide an alternate projection of those conditions to be concurrently used in feasibility evaluations of all flood damage-reduction alternatives. That alternative projection of future without-project conditions is provided in the enclosed PAR. We would welcome any further discussions with your staff aimed at resolving differences between each agency's projections; although in the absence of agreement on future without-project conditions, both should be treated as alternative scenarios as provided for in *Principles and Guidelines*.

Our PAR is provided in accordance with applicable provisions of the Fish and Wildlife Coordination Act (FWCA; 48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), but does not constitute the final report required by Section 2(b) of that Act. The enclosed PAR does not represent a change in the official position (as established in our June 11, 1982, FWCA report) of the Service and the Department of the Interior regarding the Yazoo Backwater Area Project-Yazoo Area Pump Study. Under the current study schedule, we plan to provide a supplemental FWCA report during the first quarter of Fiscal Year 2000.

The cooperation of your staff during the re-evaluation study has been appreciated. If you or your staff have any questions or comments regarding the enclosed report, please contact me at (601) 629-6600.

Sincerely,

Charles K. Baxter  
Evaluation Team Leader,  
Yazoo Backwater Area Project

Enclosure

cc: General Phillip Anderson, Mississippi Valley Division Engineer, Vicksburg, MS  
Mr. Sam Hamilton, FWS Regional Director, Atlanta, GA  
Mr. John Hankinson, EPA Regional Administrator, Atlanta, Georgia  
Mr. Sam Polles, Director, MDFWP, Jackson, MS  
Mississippi Levee Board, Greenville, MS

**A**

**Fish and Wildlife Coordination Act**

**Planning-Aid Report**

**on the**

**YAZOO BACKWATER AREA PROJECT**

Yazoo Backwater Evaluation Team  
Vicksburg Field Office  
Vicksburg, Mississippi

United States Fish and Wildlife Service  
Southeast Region  
Atlanta Georgia

September 1999  
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## INTRODUCTION

This report contains planning information and recommendations from the U.S. Fish and Wildlife Service regarding the Vicksburg District, U.S. Army Corps of Engineers' (Corps) Yazoo Backwater Area Project, an authorized portion of the Mississippi River and Tributaries Project. The Corps is currently conducting a post-authorization re-evaluation of the Yazoo Backwater Area Project in response to the 1996 Water Resources Development Act, which authorized continued planning for the Yazoo Backwater Area Pumping Plant, and removed the local cost-sharing requirement for that project. The purpose of this planning-aid report (PAR) is to provide an alternative future without-project scenario for use in evaluating the impacts of the various alternative plans, including the Service's combined structural/non-structural alternative, being considered by the Corps.

This PAR is submitted in accordance with applicable provisions of the Fish and Wildlife Coordination Act (FWCA; 48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), but neither constitutes the final report required by Section 2(b) of that Act, nor changes the official position (established in our June 11, 1982, FWCA report) of the Service and the Department of the Interior relative to the Yazoo Backwater Area Project–Yazoo Area Pump Study.

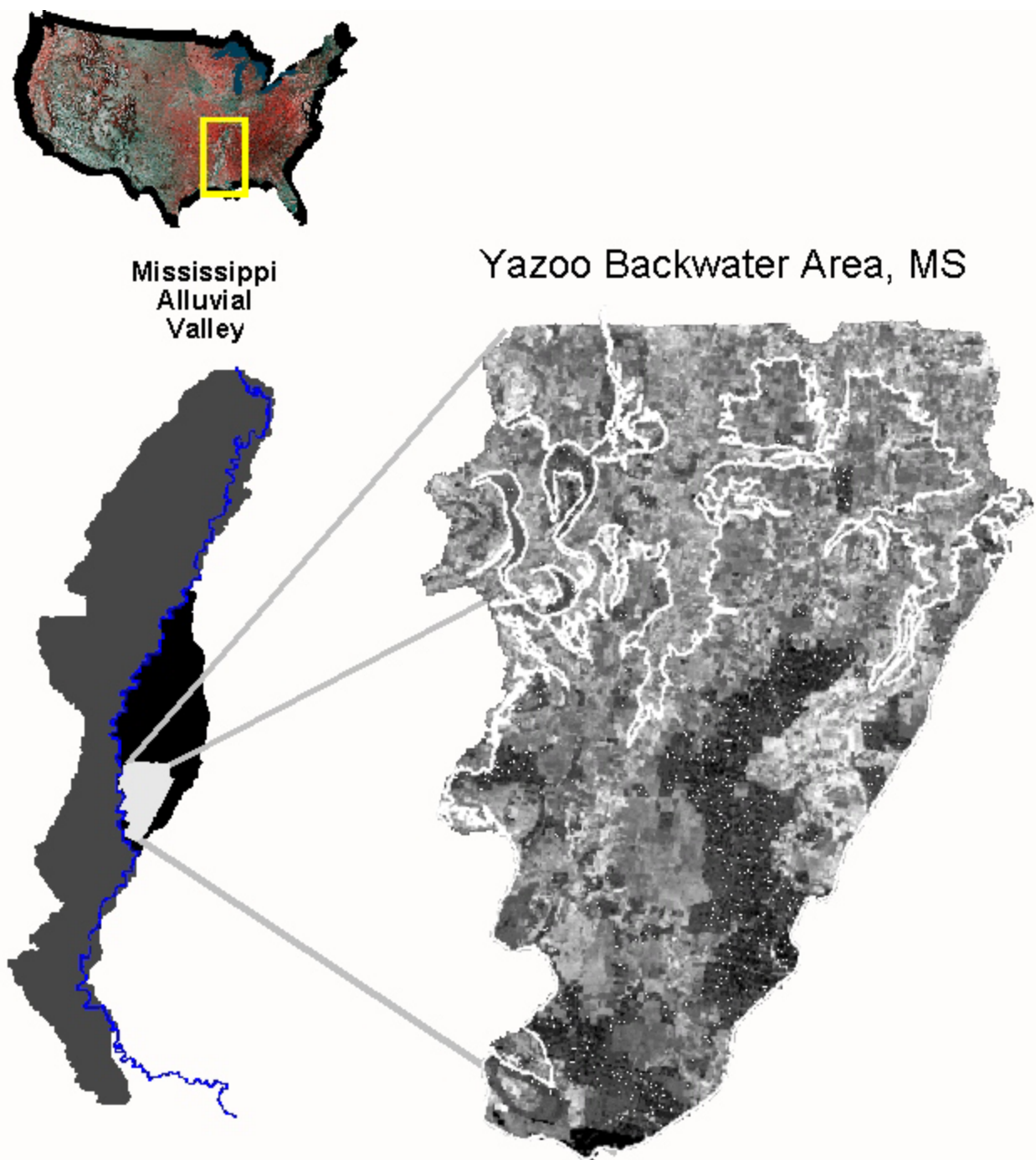
For purposes of feasibility evaluations of the Yazoo Backwater Pumping Plant alternative plans, the Vicksburg Corps District has forecasted that existing conditions will not change over the future without-project. In contrast, the Service believes that those conditions will change significantly over the 50-year period of evaluation. Because there is a high degree of uncertainty associated with the Corps projection, there is a substantial risk that project impacts will be underestimated. In dealing with questions of accuracy, risk, or uncertainty of future without-project forecasts, the U.S. Water Resources Council provided explicit guidance in their March 1983 *Economic and Environmental Principles and Guidelines for Water and Related Land Resources* to develop and utilize alternative forecasts as follows:

Section 1.4.13(a) - "Plans and their effects should be examined to determine the uncertainty inherent in the data or assumptions of future economic, demographic, social, attitudinal, environmental and technological trends. A limited number of reasonable alternative forecasts that would, if realized, appreciably affect plan design should be considered."

Supplement I, Section S2(f) - "A range of likely outcomes can then be described by using sensitivity analysis—the technique of varying assumptions as to alternative economic, demographic, environmental, and other factors, and examining the effects of these varying assumptions on outcomes of benefits and costs."

Thus, in cases where a great deal of uncertainty or disagreement exists, the use of alternative future forecasts may be the only method by which decision-makers can clearly be shown the degree of risk and uncertainty associated with the feasibility (i.e., completeness, effectiveness, efficiency, and acceptability) of each project alternative. Accordingly, the Service's planning team has developed an alternative future without-project forecast, and requests that the Corps utilize and display it as a co-equal scenario in evaluating all project alternatives, including their tentatively selected plan.

Land use is, and will remain, the dominant influence upon the well-being and viability of fish and wildlife resources in the Yazoo Backwater Area, a portion of the Mississippi Alluvial Valley (Figure 1).



**Figure 1. Location of the study area within the Mississippi Alluvial Valley.**

The remainder of this report therefore identifies the key land-use trends that shaped existing conditions, defines reasonable assumptions about the factors that will most directly affect those trends during the 50-year, without-project future, and finally, describes the methodology and results of the Service's projection of land-use conditions over that period.

## **HISTORIC TRENDS AND CURRENT CONDITIONS**

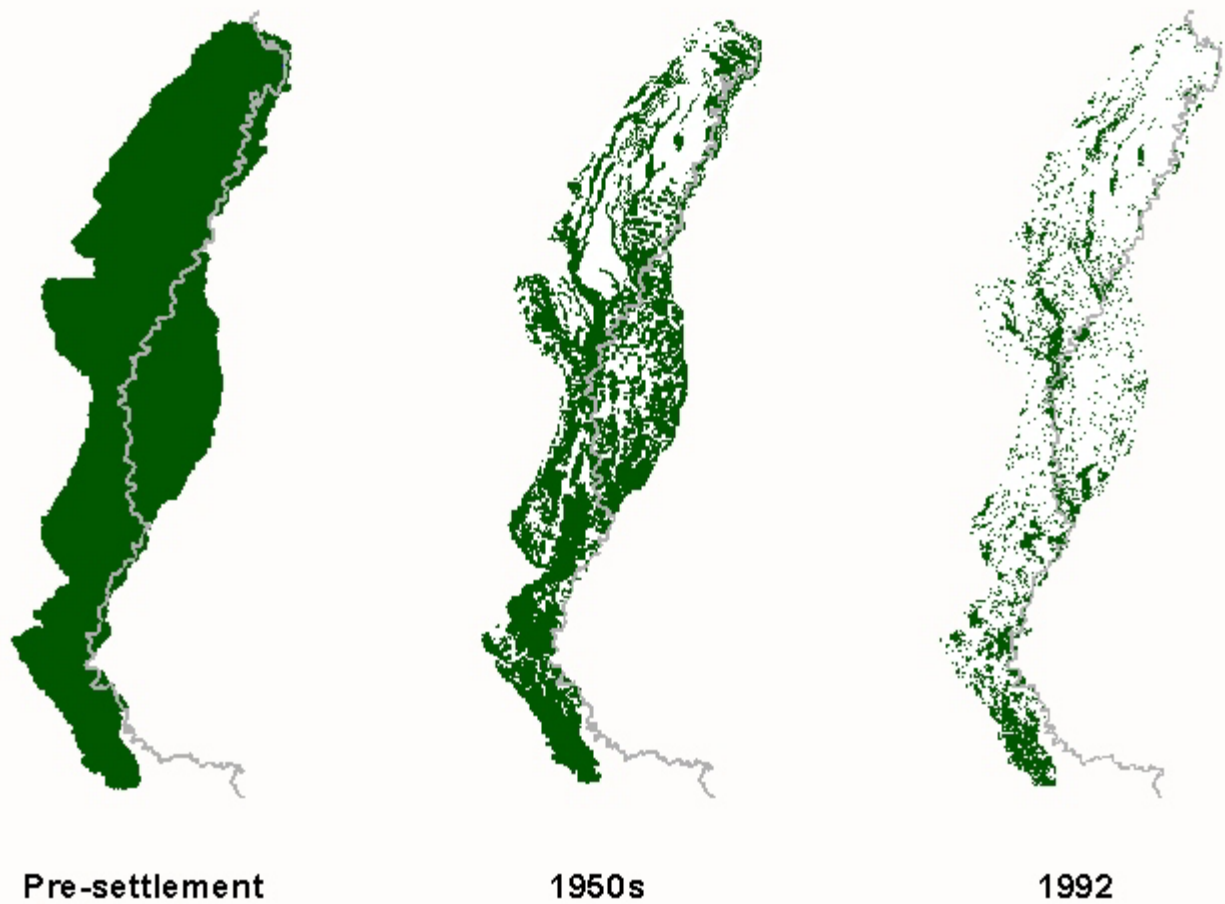
Land-use trends within the Yazoo Backwater Area have generally paralleled those of the Mississippi Alluvial Valley (MAV) as a whole. Figure 2 illustrates that the MAV itself has undergone an almost complete change since pre-settlement as approximately 75 percent of a landscape that once consisted of floodplain forest has been converted almost exclusively to agricultural production. Early settlements were typically restricted to natural levees associated with the Mississippi River and its primary meander belts. Because natural levees were the best drained and least flood-prone, settlers initially inhabited those lands. Forested lands at the highest elevations were cleared to produce food crops and silage for local consumption, and logging became an economic mainstay of the time. As settlement progressed, small-scale, local drainage and flood control projects were initiated. Simultaneously, Federal navigation improvements were constructed on the Mississippi River and numerous tributaries. As a result of those early infrastructure improvements, additional forested acreage was cleared to produce cotton and other commodity crops for export, rather than local consumption. However, up through the 1920's, agricultural expansion beyond the natural levees and terraces was limited by the direct effects of flooding, lack of drainage, and relatively poor production technology.

With the advent of Federal flood control and drainage in 1928, coupled with post-depression expansion of the national economy and increased mechanization, the stage was set for agricultural encroachment into the more poorly drained, frequently flooded portions of the MAV. Figure 3 depicts the relationship between forest cover and soil drainage characteristics as they existed in the Yazoo Backwater Area prior to the last major era of agricultural expansion. At that point in time (the early 1950's), agriculture was generally restricted to the higher, better drained soil associations. As a matter of record, the Yazoo Backwater Area was Federally recognized for its role in storing floodwaters and runoff from the upper Yazoo Delta.

The 1950's ushered in an era of major agricultural expansion into the poorly drained, frequently flooded portions of the MAV. Fueled by expanding world markets, inflating land prices, and federal flood control projects that claimed as benefits the conversion of over five million acres of forested wetlands to cropland, agricultural expansion continued into the 1970's under highly favorable economic conditions and a 20-year period that saw no major flood on the Mississippi River. From 1947 to 1977, more than 3.5 million acres of forested wetlands were converted to agriculture in Arkansas, Louisiana, and Mississippi. During the period between 1957 and 1977, 317,115 acres of forested wetlands within a 6-county (Sharkey, Issaquena, Humphreys, Yazoo, Washington, and Warren) area were converted to agriculture (MacDonald et al. 1979). By the late 1970's, however, that era of agricultural expansion had run its course in the Yazoo Backwater Area. Figure 4 illustrates that land-use conditions had essentially become the reverse of those that had existed in the early 1950's; 65 to 75 percent of the most frequently flooded, poorly drained soil associations in the Yazoo Backwater Area had been cleared.

In the Yazoo Backwater Area (and the MAV as a whole), the late 1970's and the decade of the 1980's was a period of stable land use, but turbulent economic conditions within the agricultural community. The 1973 flood, which inundated nearly 15 million acres of the MAV including about

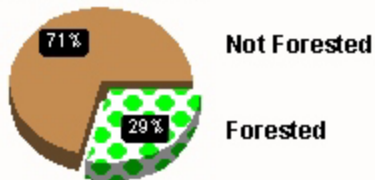
## Forest Cover in the MAV



**Figure 2. Change in forest cover from pre-settlement to 1992. Approximately 75 percent of the original pre-settlement floodplain forest has been converted to agricultural production.**

## Soil Drainage / 1950's Forest Cover

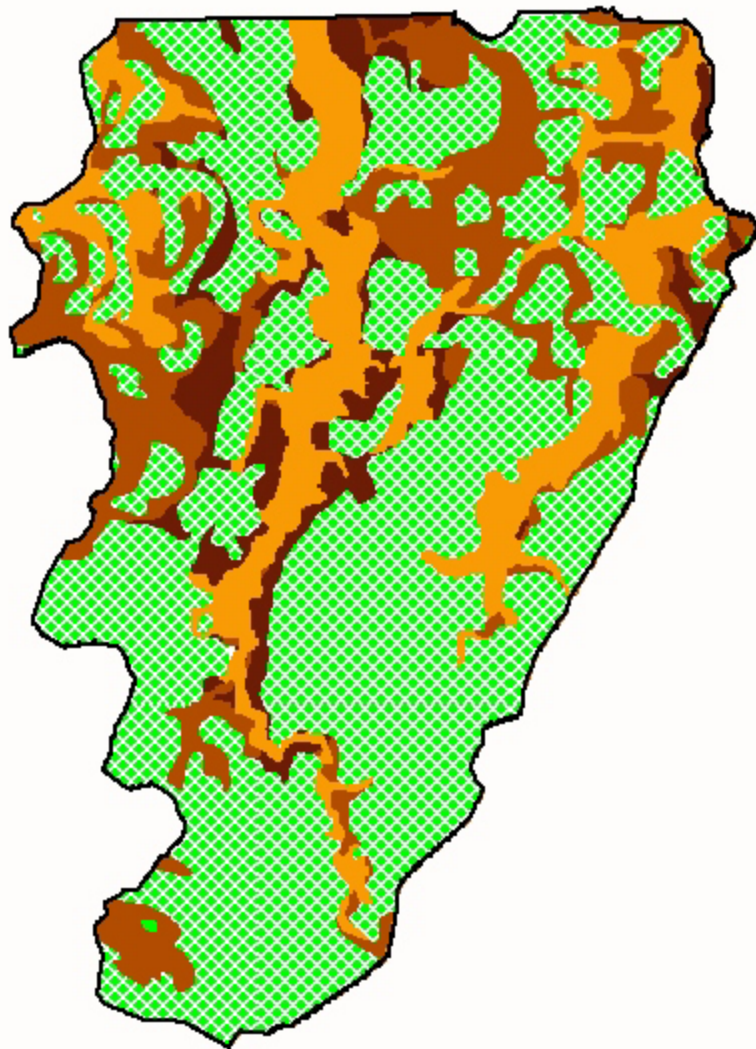
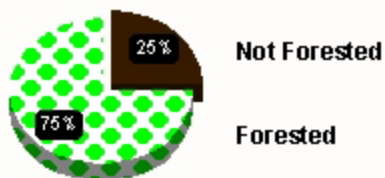
MWD - SP Drained



SP - P Drained



P - VP Drained



**Figure 3. Relationship between forest cover and soil drainage characteristics as they existed in the Yazoo Backwater Area prior to the last major era of agricultural expansion.**

## Soil Drainage / 1990's Forest Cover

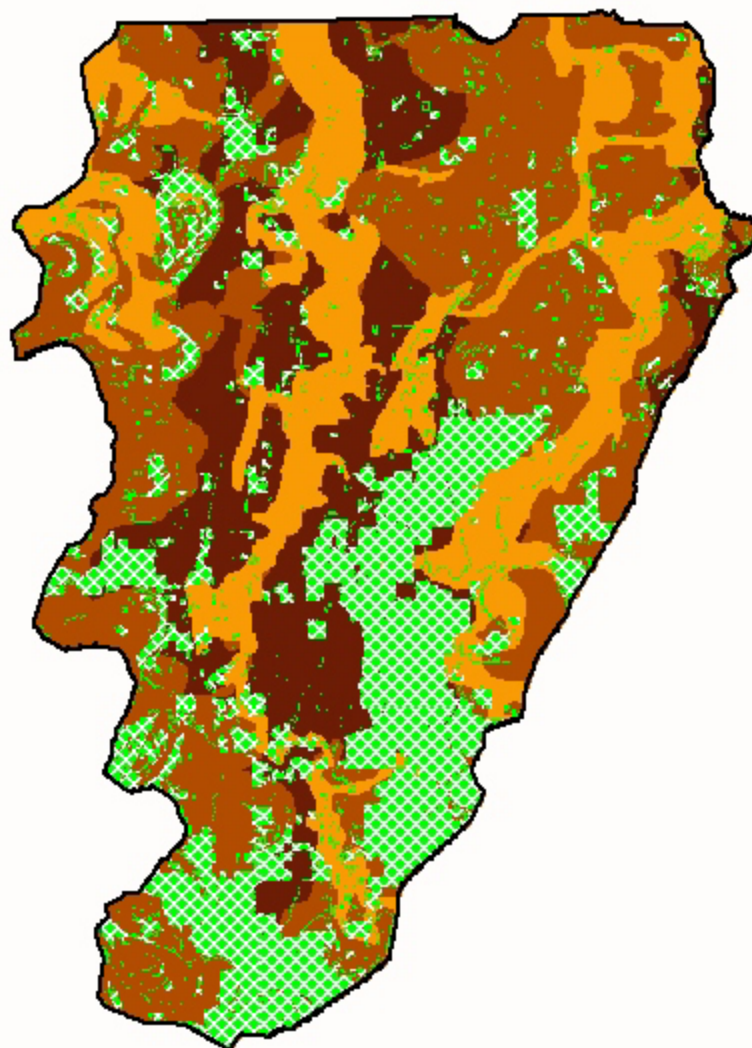
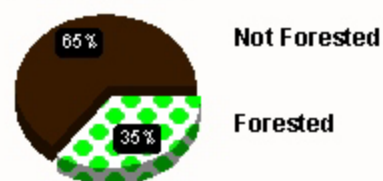
MWD - SP Drained



SP - P Drained



P - VP Drained



**Figure 4. Relationship between forest cover and soil drainage characteristics as they existed in the Yazoo Backwater Area after the last major era of agricultural expansion.**

640,000 acres of the Yazoo Backwater Area, broke the 20-year dry spell; and a period of normal to above-normal rainfall produced significant flooding within the Backwater Area in 1974, 1975, 1979, 1982, 1983, and 1989. The implications of farming high-risk areas came to the forefront at a time when the condition of the agricultural economy was essentially the reverse of the expansion years. Delinquent loans and foreclosures became commonplace in the 1980's. The Federal Land Bank, the Farmers Home Administration (FmHA), insurance companies, and other private lending institutions became major landowners, holding an inventory most often represented by cleared wetlands.

The combination of economic and hydrologic conditions that had made marginal yields on high-risk lands profitable proved to be temporary and transient. Land use and land capability had become substantially misaligned, and "land that should never have been cleared" became part of the lexicon of the agricultural community. Thirty years of agricultural expansion had left a landscape that failed to meet the tests of either economic or ecological sustainability.

As the farm crisis in the early 1980's brought an almost immediate end to the long-standing trend of agricultural expansion and intensification in wetlands, the socio-political and socio-economic forces that had driven that trend also began to change. Passage of the 1985 Food Security Act (or "Farm Bill") marked a public recognition that the factors (discussed in greater detail below) underlying historic land-use trends, which had previously been treated as almost mutually exclusive, should be addressed in the context of their interdependency. Federal programs and policies to remove marginal agricultural lands from production; reduce damage-susceptible floodplain development and associated flood disaster payments; protect and restore wetlands; and provide for sustainable ecological and economic development have been steadily advanced since then. Such changes were given additional impetus by the 1993 flood (and subsequent post-flood evaluations) on the upper Mississippi River.

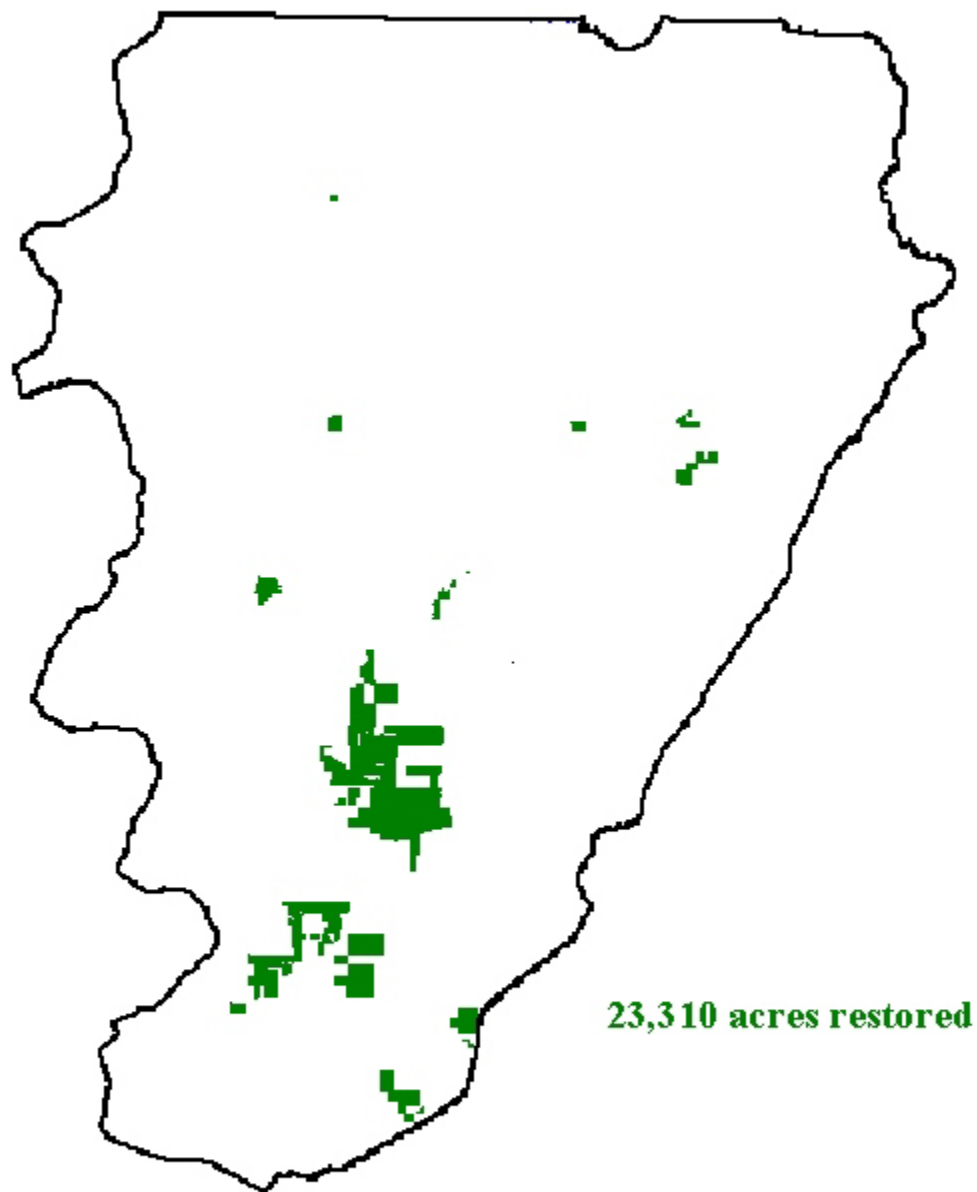
During the 1980's, land use remained relatively constant. However, between 1990 and 1998, the historic wetland decline was replaced by a new land-use trend. More than 40,700 acres of cleared agricultural lands were restored to wetland conservation uses, and an additional 16,664 acres of forested lands were protected during that 8-year period. As will be discussed in greater detail, our spatial analyses indicate that the majority (82 percent) of those wetland restoration and protection efforts occurred in the most frequently flooded portions of the project area.

Since 1985, private landowners within the Yazoo Backwater Area have declared intentions to enroll over 83,000 acres of prior-converted and farmed wetlands in the Wetland Reserve Program (WRP), of which, slightly more than 39,000 acres have been accepted. Easements have been recorded, and restoration is underway on more than 23,000 acres (Figure 5). Other programs involving public land acquisition, restoration of mitigation lands, and voluntary foreclosure/debt forgiveness have also resulted in wetland protection and restoration on a significant acreage. Taken together, it is apparent that a significant public demand for, and local willingness to participate in, such programs and efforts exists. In the absence of further federal flood control and drainage, that demand (as indicated below) can reasonably be expected to persist for the next several years.

## **FUTURE WITHOUT-PROJECT ASSUMPTIONS**

The historic and current land-use trends described above resulted from a complex interplay of numerous causative factors which for the sake of discussion will be categorized as socio-political/institutional, socio-economic, and ecological. The socio-political/institutional factors most strongly

## Wetland Reserve Program Lands



**Figure 5. Cleared acres restored in the Wetland Reserve Program during the period 1990-1998.**

influencing land-use trends range from large-scale flood control/drainage projects to the myriad statutes, policies, and directives in support of both agricultural development and protection of the environment. The primary socio-economic factors include increasingly efficient production technologies, crop/timber prices, land values, agricultural and silvicultural subsidies, disaster payments, various incentive programs (including those that support sustainable development, wetland conservation, and restoration on marginal agricultural areas), and the economic capabilities and goals of individual landowners. Ecological factors of most significance include climate, hydrology (i.e., frequency, extent, and duration of flooding), soil drainage characteristics, and vegetation.

Over time, those causative factors described above have increased in both number and complexity, while becoming ever more dynamic and interdependent. Thus, changes in the status of one factor (or category of factors) catalyze or influence changes in the others. For example, as native Americans and settlers focused on development to meet their subsistence needs during the initial settlement period, ecological factors dominated land-use decisions, while economic factors played a lesser role. In contrast, technological advances relating to mechanized land clearing and agricultural production, acting in concert with federal policies and programs, as well as variations in foreign economies and world markets, have profoundly affected land-use trends since World War II. Ironically, the influence of ecological factors--which have remained relatively constant over the entire history of land-use development in the Yazoo Backwater Area--are increasingly acknowledged as key elements in today's efforts to define and attain economically and ecologically sustainable land-uses.

In considering land-use projections over the next 50 years, it is worth noting that the past half-century has seen 3 distinct trends in land use within the project area: a 30-year period of wetland clearing and conversion, followed by a 10-year period of stabilization, followed by a 10-year period of wetland restoration. Given that degree of trend variability alone, we do not believe that current land-use conditions will remain unchanged over the next 50 years, as predicted by the Corps. Significantly, independent reforestation projections tend to support our thesis that changes in land-use trends are inevitable. According to Stanturf et al. (1998), up to 449,000 acres of land (primarily in Mississippi, Louisiana, and Arkansas) subject to spring and early summer backwater flooding could be reforested *over the next decade* in the Lower Mississippi Alluvial Valley (LMAV). Of that total, he cites Natural Resources Conservation Service (NRCS) projections of an additional 118,000 acres expected to be enrolled in WRP by 2005. Those projections are also consistent with the policy goal of the President's Clean Water Action Plan to expand WRP enrollment up to 250,000 acres each year.

Although the future can never be predicted with absolute certainty, land-use trends and their underlying causative factors can be identified and assessed. Accordingly, the Service planning team has documented, by category, the following basic assumptions regarding changes in the above-described factors that can be expected to occur during the future-without project. Following each assumption, a short, italicized statement of its significance is also provided.

### **Socio-Political/Institutional Assumptions**

The socio-political/institutional forces and factors considered most relevant to future land-use in an agriculturally dominated landscape situated within the Nation's largest floodplain are those related to:

Flood control, floodplain management, and flood hazard mitigation;

Agricultural support, expansion, or intensification; and

Environmental improvement or protection.

Assumption 1--Flood control. By definition, the Yazoo Backwater Pumping Plant will not be constructed. Local interests will, likewise, not construct the project independent of Federal involvement. Corps of Engineers projects under construction elsewhere within the watershed will be completed, however, and the existing federal flood control/drainage system will be maintained. Accordingly, the Yazoo Backwater Area will continue to receive and store drainage and floodwaters from those projects.

*The ability to control or otherwise manage backwater flooding will not improve; and the effects of headwater drainage and flooding will continue and, in fact, increase commensurate with upstream drainage improvements. Thus, Assumption 1 tends to support the trend toward continued wetland restoration on poorly drained, frequently flooded agricultural lands in the Yazoo Backwater Area.*

Assumption 2--Floodplain management and flood hazard mitigation. The “sense of the Nation” encapsulated in the 1994 report of the Interagency Floodplain Management Review Committee, *Sharing the Challenge: Floodplain Management into the 21<sup>st</sup> Century*, will move traditional, structural-only approaches to flood control (as typified by the Mississippi and Rivers Tributaries Project) toward a more balanced approach of floodplain management and flood hazard mitigation that includes both non-structural flood control and the restoration and management of natural floodplain values.

*Broad public support for laws, programs, and policies aimed at achieving greater consistency among hitherto divergent floodplain management efforts are not likely to abate, particularly at the Federal level. The Interagency Review Committee’s 1994 report concludes that: “The division of responsibilities for floodplain management activities among and between...governments needs to be clearly defined. Within the Federal system, water resources in general and floodplain management in particular, need better coordination.” Assumption 2 tends to support the current trend of wetland restoration on poorly drained, frequently flooded agricultural land within the Yazoo Backwater Area.*

Assumption 3--Agricultural Policies Relating to Expansion or Intensification. Agricultural policies and institutional forces within the agricultural community will increasingly reflect goals and objectives associated with long-term sustainability rather than expansion of the agricultural land base.

*This assumption likewise supports the trend of wetland restoration on poorly drained, frequently flooded agricultural land within the Yazoo Backwater Area. Programs such as the Conservation Reserve Program (CRP) and WRP that have emphasized retirement of environmentally sensitive lands are themselves a reflection of more fundamental policy objectives and concerns within the agricultural community. Those concerns, popularly described as “the search for sustainable agriculture,” run counter to and have generally replaced the socio-political/institutional forces that drove the post-War expansion of the Nation’s (and the MAV’s) agricultural land base.*

Assumption 4--Environmental Improvement and Protection. The social, political, and institutional forces supportive of wetland protection and restoration and water quality improvement (particularly

improvements associated with non-point source agricultural run-off) are expected to continue and increase over the foreseeable future.

*While we do not expect the national concern for wetland conservation to abate, we assume that state and national interest in water quality improvement and non-point source pollution abatement will in fact increase. As those two forces tend to reinforce one another on the issue of restoring high-risk agricultural lands to wetlands, we believe Assumption 4 supports a continuation of the current trend of wetland restoration on poorly drained, frequently flooded agricultural land within the Yazoo Backwater Area.*

## **Socio-Economic Assumptions**

The socio-economic factors assumed to be of most relevance to future land-use within the Yazoo Backwater Area are those having a direct bearing on agricultural profitability and those affecting the profitability of alternative land-uses, in particular forest-based land uses.

Assumption 5--Agricultural Economic Outlook. While long-term demand for food and fiber will increase with an expanding human population; overproduction, surplus, and world market conditions will continue to adversely affect the farm economy over the next several years.

The U.S. Department of Agriculture's *Agricultural Baseline Projections to 2008* states that, during the period of forecast: "...gains in farm income are less than inflation, so real farm income declines," and "...real prices are projected to continue to decline over the longer term, as productivity gains continue to outpace growth in demand."

Assumption 6--Agricultural Subsidies. The trend toward a gradual reduction of direct and indirect agricultural subsidies will continue for the foreseeable future. The current Federal budgetary emphasis seems to be on emergency appropriations to buffer the short-term impacts of a depressed agricultural economy rather than reestablishing long-term subsidies which run counter to international efforts to reduce trade barriers and establish more "open" markets. Likewise, conservation incentives are expected to increase over the long-term as the linkage between production programs and conservation programs that began with the 1985 Farm Bill gradually strengthens, particularly those incentives related to conserving environmentally sensitive lands and improving water quality.

Assumption 7--Incentives for Forest-Based Land Uses. The economic attractiveness of forest-based land uses will continue to increase for the foreseeable future, especially in areas where long-term agricultural sustainability is at risk. Rising stumpage prices; innovative and efficient reforestation techniques (e.g. softwood/hardwood inter-plantings) that produce an earlier economic return; increasing valuation of private recreational lands (particularly in the vicinity of public recreational lands); and development of carbon sequestration markets will synergistically produce a gradual increase in the economic position of forest-based land uses. Moreover, the economic values attached to wildlife oriented recreation are expected to increase over time. Hite (1998) estimated the current value of such activities in the Delta as \$540-720 million annually.

*Assumptions 5, 6, and 7 all support the current trend toward wetland restoration on poorly drained, frequently flooded agricultural land within the Yazoo Backwater Area. Moreover, they indicate a movement toward more balanced local and regional economies within the project area and the MAV*

*as a whole. They point to a gradual realignment of land use and land capability and an increasingly sustainable agro-forestry land base.*

## **Ecological Assumptions**

Assumption 8--Hydrologic Conditions. Over time, the “wetness” of the project area will continue to increase in response to gradual increases in the flowline of the Mississippi River attributable to basin-wide development; increasing run-off from within the Steele Bayou/Big Sunflower watersheds; and continued sedimentation.

Assumption 9--Edaphic and Climatic Conditions. By their nature, edaphic conditions are not expected to change, and the natural drainage restrictions of the project area’s alluvial soils will continue. Climatic factors will change only to the extent anthropogenic “global warming” becomes a reality. In this regard, most projections of global warming allude to increased precipitation rates within the southeastern United States.

*Assumptions 8 and 9 tend to support a gradual and long-term movement away from agriculture to forest-based land uses within the poorly drained, frequently flooded portions of the Yazoo Backwater Area.*

A final note regarding causative factors and assumptions--the conditions that made farming high-risk areas profitable during the 1960s and 1970s could reasonably be expected to recur sometime during the 50-year future without-project period of analysis. In accordance with the preceding discussion, however, such a recurrence will not take place in the immediate future, and certainly not before a significant acreage is restored to a forested land use. In contrast to the conditions at the beginning of the last major agricultural expansion, the significant and substantial socio-political and socio-economic forces currently in place will tend to deter rapid and immediate conversion (or re-conversion) of wetlands to agriculture. Stated in the vernacular, a return to \$9-a-bushel soybeans 10 years from now should not be presumed to have the same effect it did 20 years ago. While such a price rebound would certainly affect the current and future trend toward gradual realignment of land use and land capability, it would not likely produce immediate and large-scale wetland conversion, as was the case during the last major agricultural expansion.

## **FUTURE WITHOUT-PROJECT FORECAST**

### **Methodology**

The Service’s projection of future without-project conditions considers two potential land-use changes: the conversion of the existing forested land base to agriculture; and the restoration of previously cleared lands to forested wetlands. The Corps of Engineers has projected no further clearing and conversion of forested wetlands to agriculture in the future without-project, and the Service concurs with that projection. As indicated by the above discussion of assumptions, however, the Corps projection that current land uses will remain static does not address the very real and well-established trend toward wetland restoration of marginal agricultural land. Thus, our methodology (and the remainder of this section) is directed at assessing *wetland restoration* trends, and projecting the future rates of change in those trends.

Any projection of future without-project conditions in a major backwater system of the Mississippi River will in effect be a projection of the balance, or dynamic equilibrium, expected to exist between agriculture and wetlands. The Corps projection of “no change” is essentially one of static equilib-

rium--a steady-state is presumed to have been achieved, and that state is assumed to persist unchanged for the next half-century. On the other hand, the Service believes that the long-term balance between agriculture intensification and wetland restoration will reflect an underlying balance between land use and land capability as the latter (land capability) is affected by flood control and drainage. In that the project in question is proposed for the expressed purpose of affecting land capability, we believe that any projection (including the Corps') that does not explicitly take into consideration relationships between land use and land capability is flawed, since such a projection does not acknowledge or account for either the primary purpose or the impacts of the project. Accordingly, the Service's methodology involves applying geographic information system (GIS) technologies to assess the relationship of wetland restoration (i.e., land use) to flooding and soil drainage characteristics (i.e., land capability). Four basic steps are involved:

Assess, by flooding/drainage class, the spatial extent of restoration occurring during the period 1990-1998;

Compute annual rates of change;

Project future annual rates of change; and

Adjust projected restoration acreage on the basis of acreage available within each flooding/drainage class and programmatic constraints.

In assessing wetland restoration trends, the Service focused on the period 1990-1998 as being most reflective of landowner-driven decisions to restore previously cleared areas to wetlands. Although wetland protection and restoration efforts extend back at least to 1935 and the establishment of Delta National Forest, these sorts of land use decisions were initiated by conservation agencies and organizations rather than affected landowners and are more a reflection of national conservation programs than of local interest in realigning land use and land capability.

The Service defined "areas restored to wetlands" as lands enrolled in the WRP, FmHA inventory lands under wetland restoration easements, and cleared lands situated within state wildlife management areas and National Wildlife Refuges, recognizing that such lands may be in varying states of restoration. Geo-spatial data layers were created for each category, which allowed the acreage and location of such lands to be assessed with respect to flooding and drainage characteristics. Based on those data, the project area was divided into three "flood zones" and three soil drainage classes. The three flood zones are defined as follows:

Zone 1 – The area subject to inundation by a 2-year frequency flood event (50 percent chance of occurrence) lying *at or below* 91' NGVD (National Geodetic Vertical Datum).

Zone 2 – The area subject to inundation by a 2-year frequency flood event lying *above* 91' NGVD.

Zone 3 – That portion of the project area lying above and thus not inundated by the 2-year frequency flood event.

Zones 1 and 2 effectively divide the 2-year event into two segments in order to distinguish between backwater and headwater flooding, respectively. At the Steele Bayou Drainage Structure (the most downstream point in the project area), the elevation of the 2-year event is 91' NGVD. In that the Service defines a backwater flood as a flat-pool event, all land physically below 91' NGVD would be inundated by a 2-year *backwater* event. This is the area depicted as Zone 1. Conversely, all land within the 2-year event that physically lies *above* 91' NGVD is affected (at the 2-year frequency) by headwater flooding only and has been designated as Zone 2. Although both Zones 1 and 2 are inundated by a 2-year frequency event, the nature of backwater flooding is such that a 2-year event in Zone 1 will typically be of longer duration than a 2-year event in Zone 2, thus the distinction. The remainder of the project area, that portion lying above the 2-year event, is defined as Zone 3. Figure 6 depicts the location of all three zones.

One primary and two secondary geo-spatial data layers were then used to divide the project area into three soil drainage classes. Figure 7 depicts the location of those soil drainage classes, which are defined as follows:

P-VP – Areas that consist predominately of soils classified by NRCS as “poorly drained” to “very poorly drained.”

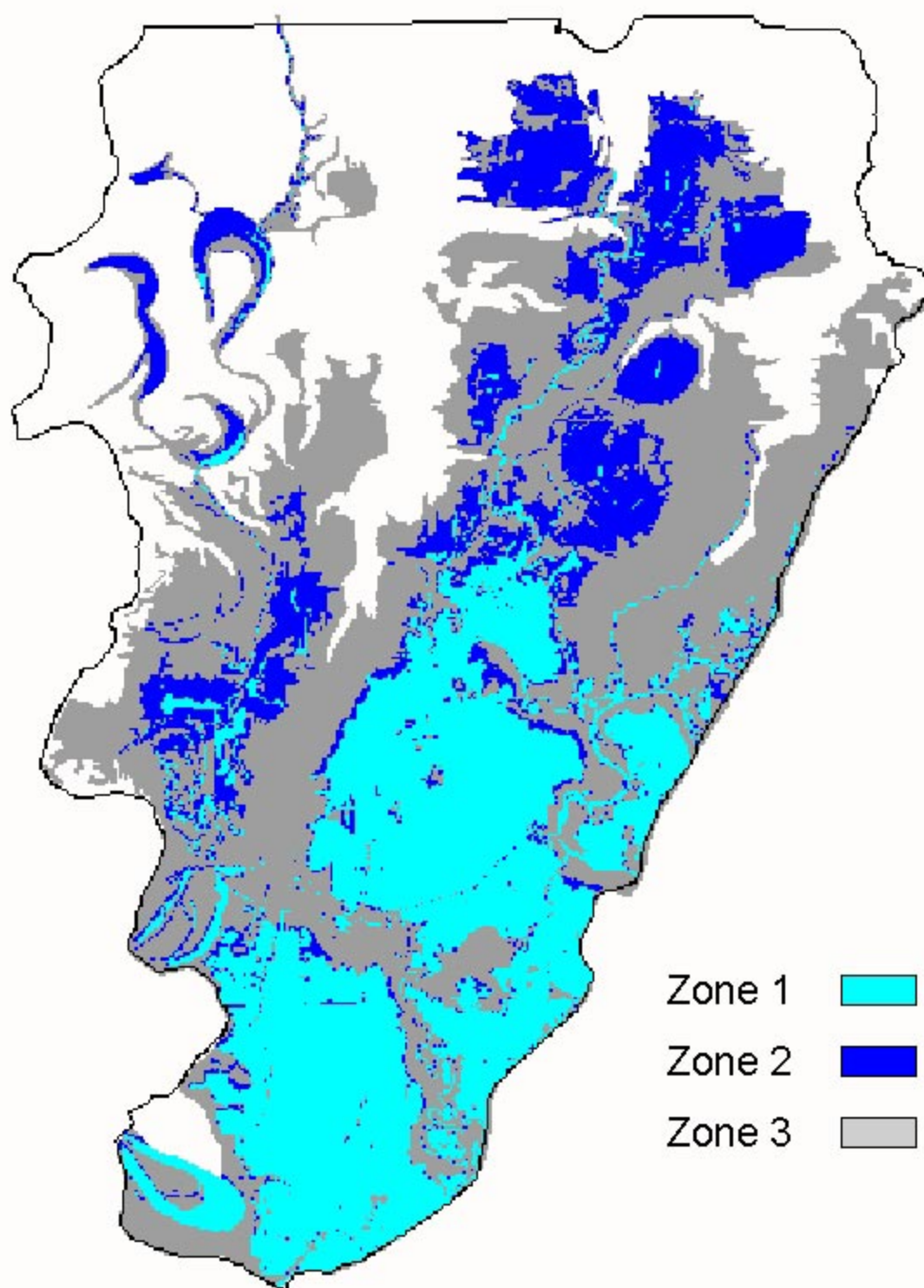
SP-P – Areas that consist predominately of soils classified as “somewhat poorly drained” to “poorly drained.”

MW-SP – Areas that consist predominately of soils classified as “moderately well drained” to “somewhat poorly drained.”

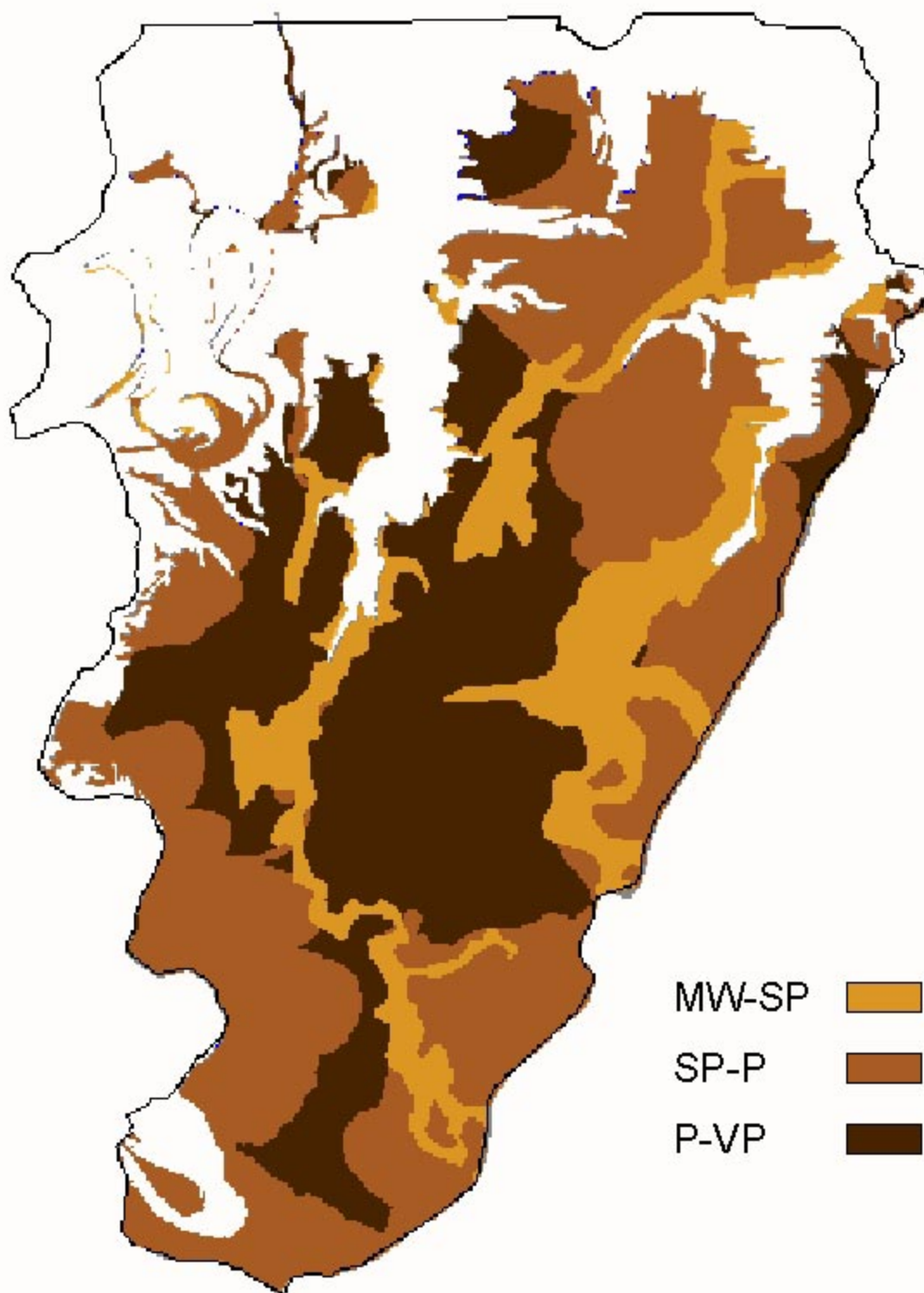
The primary data layer used was USDA's STATSGO soils data base; the secondary layers were geomorphology (Saucier 1994) and USGS Digital Elevation Models (DEMs). STATSGO allows soils to be mapped at the association level. In addition, it provides tabular descriptions of the soil series within each association and their relative proportion, as well as the drainage classification of each series. Saucier's geomorphology data and DEMs were used to distinguish natural levees from point bar formations in those soil associations containing both. This distinction was considered necessary because natural levees uniformly and consistently contain the better drained soils. The detailed descriptions of soil associations contained in County Soil Surveys were then utilized to determine those soil series most likely to be associated with either natural levees or point bar formations.

Overlaying flood zones with soil drainage classes produced nine spatially distinct analytical units (Figure 8). The aforementioned wetland restoration data layers were then overlain on these nine analytical units to assess the extent of wetland restoration within each of the flooding/soil drainage classes.

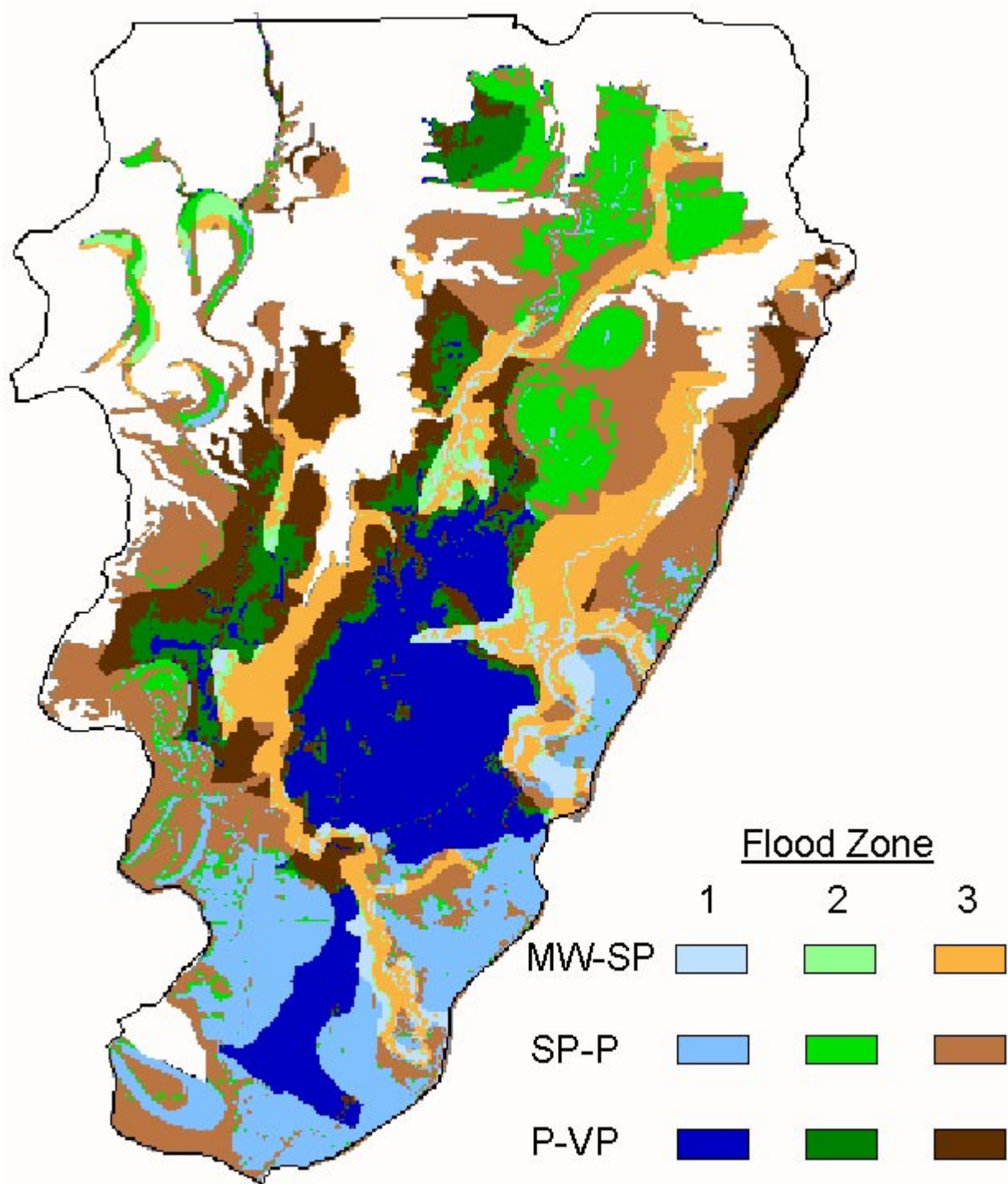
At this point in the analysis, annual rates of change and projected restoration could have been computed.



**Figure 6. Three flood zones of the Yazoo Backwater Area -- Zone 1 = the area  $\leq 91'$  inundated by the 2-year frequency event, Zone 2 = the area  $> 91'$  inundated by the 2-year frequency event, and Zone 3 = the area inundated at  $> 2$ -year event .**



**Figure 7. Three soil drainage classes of the Yazoo Backwater Area - - MW-SP = Moderately Well to Somewhat Poorly drained soils, SP-P = Somewhat Poorly to Poorly drained soils, and P-VP = Poorly to Very Poorly drained soils.**



**Figure 8. Restoration trends (1990-1998) were spatially analyzed within the intersection of 3 flood zones and 3 soil drainage classes.**

However, the Service methodology was further refined to consider two specific constraints--the acreage actually available within each flooding/soil drainage class, and the potentiality that "program caps" associated with WRP and CRP could limit restoration within the near term. Although the Service did not assume that all future restoration would be solely associated with those USDA programs (indeed, carbon sequestration has a potentially greater impact), their potential constraints were specifically taken into account, which required additional analyses.

Current USDA rules and regulations provide that no more than 25 percent of the agricultural acreage within any given county can be enrolled in WRP/CRP with the proviso that local county committees have the prerogative of raising the cap to 30 percent. In that the caps operate on a county-by-county basis, the nine analytical units were further subdivided by county. Overlaying the boundaries of six counties on nine flooding/soil drainage classes produced 54 analytical units. The restoration occurring from 1990 through 1998 was then computed for each of the 54 units, along with the remaining acreage available within each unit. Only at this point was the observed rate of change (OROC) computed (by flood zone, by soil drainage class, and by county).

In arriving at a projected rate of change (PROC), the Service did not consider it appropriate to simply extend the 1990-1998 OROC into the future. The OROC associated with the WRP was considered to be most reflective of *landowner-driven* realignments of land use and land capability. Accordingly, the Service's PROC is primarily an extension of that portion of the 1990-1998 OROC attributable to the WRP. Only one other factor entered into the computations, that being public land acquisition previously identified and planned by the Service in Washington County. As a result, the Service's PROC is smaller than or equal to the current rate of change in 50 of the 54 analytical units.

The PROC was then applied over the 50-year period of analysis to compute a projected wetland restoration acreage for each of the 54 analytical units. If at any point during the period of analysis, the projected acreage exceeded that physically available, the PROC was reduced to zero and no further restoration was projected for that unit. Projections were then summed by county and compared to the WRP/CRP program caps to determine if further reductions were appropriate. In that 4 of the 6 counties extend beyond the project area, program caps for those counties were proportionately adjusted to reflect the 1998 county-wide distribution of WRP lands.

## Results

The results of the first phase of analysis, the relationship between wetland restoration and flooding/soil drainage characteristics, is displayed in Table 1. Those data are reflective of the pressure that land capability can exert on long-term land use. Indicative of the impact of flooding is the fact that 82 percent of the restoration has occurred within the 2-year event. Looking at soil drainage alone, 94 percent of the restoration acreage is situated in the two most poorly drained drainage classes, P-VP and SP-P. But perhaps most telling is the fact that 74.4 percent of the wetland restoration that occurred between 1990 and 1998 is situated in only two of the nine flooding/drainage classes—those considered by the Service to be the “wettest”, Zone 1-- P-VP and SP-P. These data are even more significant considering that none of the three programs responsible for the restoration explicitly pro-rates restoration on the basis of flooding/soil drainage criteria. Considering that practically all of the restoration sites were cleared during the last major era of agricultural expansion, the data in Table 1 support the Service’s conclusion that *ongoing restoration reflects a realignment of land use and land capability that will continue into the future, absent major hydrologic and hydraulic intervention.*

Table 1.  
Distribution by Flooding/Drainage Class of  
Wetland Restoration Occurring Within the Yazoo Backwater Area  
1990-1998

Soil Drainage Class	Flooding Class			Total
	Zone 1	Zone 2	Zone 3	
MW-SP	1,698	129	589	2,416
SP-P	12,885	938	5,479	19,302
P-VP	17,427	452	1,134	19,013
Total	32,010	1,519	7,202	40,731

Table 2 summarizes the *projected* restoration acreage within each of the nine flooding/soil drainage classes. **The Service projects that approximately 43,432 acres of cleared agricultural lands would be restored to wetlands under future without-project conditions.** Most of the restoration (83 percent) would occur within the area inundated by the 2-year frequency event (i.e., Zones 1 and 2). Moreover, 70 percent (30,300 acres) is projected to occur within Zone 1, the area affected by backwater flooding at the 2-year frequency event. This projection, considered accumulatively with existing restoration (32,010 acres), means that 86% of Zone 1 would be restored to wetlands under future without-project conditions.

Table 2.  
Distribution by Flooding/ Drainage Class of  
Wetland Restoration Projected to Occur Within the Yazoo Backwater Area  
1999-2048.

Soil Drainage Class	Flooding Class			Total
	Zone 1	Zone 2	Zone 3	
MW-SP	2,078	11	586	2,675
SP-P	15,380	2,850	3,892	22,122
P-VP	12,835	2,750	3,050	18,635
Total	30,293	5,611	7,528	43,432

Tables 3a through 3c display the existing and projected wetland restoration within each of the 54 county-specific analytical units. Each table also displays the 1990 to 1998 OROC, the acreage potentially available for restoration, and the PROC. As indicated in the previous discussion of methodology, if the projected acreage exceeded the acreage available, the former was reduced to coincide with the latter. That situation occurred in 5 of the 54 analytical units, all of which were within Zone 1 (the area having the highest OROC and PROC). Because of the constraints imposed by available acreage, the WRP/CRP program cap limited the projected acreage in only one county, Warren.

### Discussion and Conclusions

Viewed from a landscape perspective, the Service's projections indicate that most (86%) of that area previously characterized by the Corps as the "lower and upper sumps" (Zone 1) would be restored to a forested wetland land-use in the future without-project (indeed 44% of this restoration has already occurred); and an additional 13,100 acres would be restored to wetlands on frequently flooded and/or poorly drained soils elsewhere within the project area. This projection is consistent with the Service's assessment that agriculture within the most frequently flooded, poorly drained segment of the Yazoo Basin cannot be sustained indefinitely absent further and extensive hydro-logic modifications. Several factors combine to make the Service projection conservative:

- The projected rate of change in wetland restoration is less than that which occurred from 1990 to 1998.

As indicated previously, the PROC was based primarily on the acreage enrolled in only one program, WRP. While the OROC associated with WRP is considered to be most reflective of *landowner-driven* realignments of land use and land capability, future programs and markets such as carbon sequestration could substantially increase the future rate of change.

- The effects of CRP were not factored into the Service analysis due to a lack of available geo-spatial data.

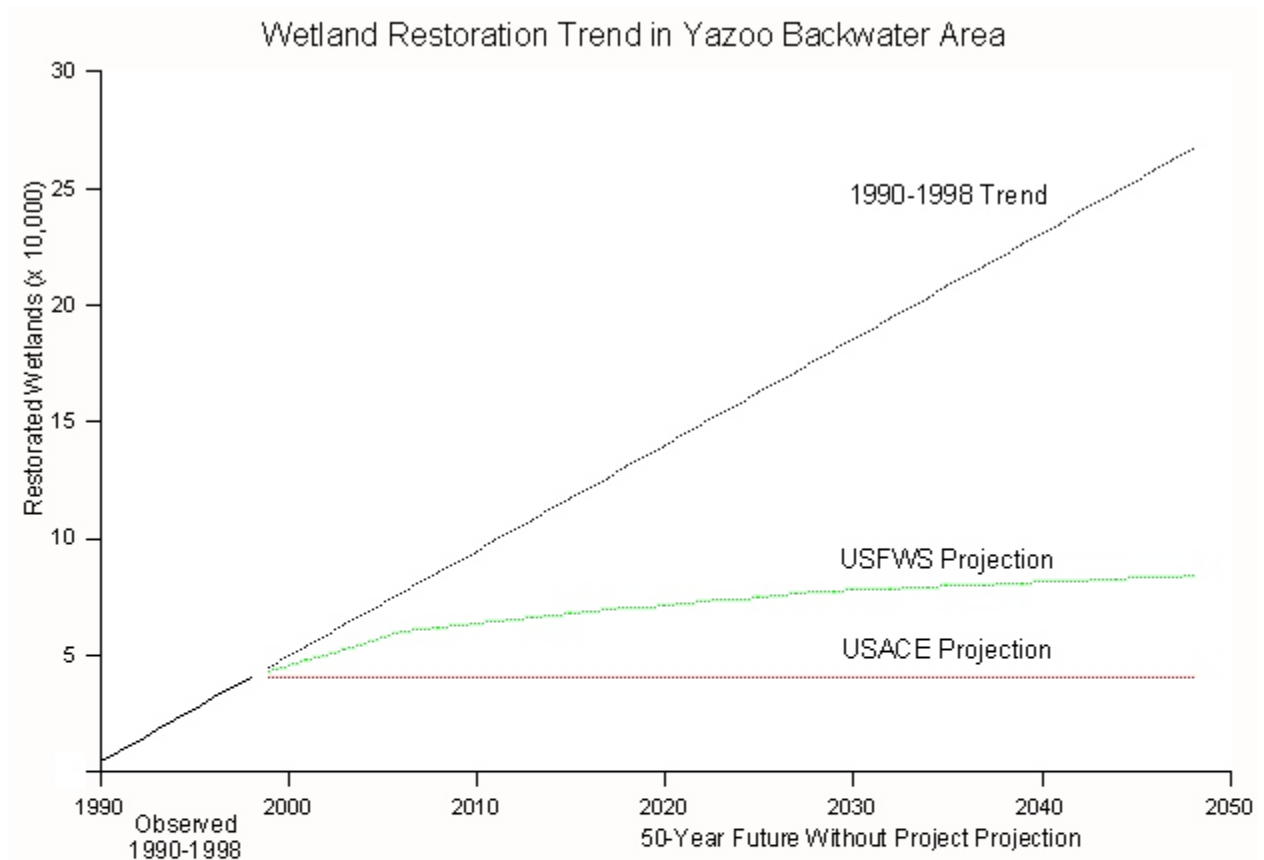
Tabular data indicates that as much as 9,700 acres of cleared agricultural land may have been enrolled in CRP wetland restoration practices within the project area. Factoring in these landowner-driven land-use changes would substantially increase the PROC.

- The demand for reforestation was not transferred from one flooding/drainage unit to another once the available land within that unit was restored.

The high rate of change associated with Zone 1 results in nearly all available land within that zone being taken up in approximately fifteen years. This demand was not transferred to other flooding/drainage units.

- No consideration was given to the likelihood that the “wetness” of the project area will increase over time in response to gradual increases in the flowline of the Mississippi River; increasing run-off from the Steele Bayou/Big Sunflower watersheds; or continued sedimentation.

The Service concludes that land-use and land capability within the Yazoo Backwater Area have become substantially misaligned and that ongoing restoration reflects a realignment that will continue in the absence of major hydrologic intervention. The Service projection of future without project conditions is predicated on the notion that fundamental relationships exist between land use and land capability. While societal attitudes, values, mores, and judgements can override and obscure such relationships, the natural constraints imposed by flooding and drainage within the alluvial valley of the Mississippi River have long been recognized socially, politically, and culturally. Since its inception, the Mississippi River and Tributaries Project has been directed at altering those constraints. Project-induced clearing and agricultural intensification have been central to its economic justification; and its impacts upon wetland conversion have been documented at the highest levels (Department of the Interior, 1988). The Service does not believe it reasonable to assume that now, in the most flood-prone, poorly drained portion of the Yazoo Basin, those relationships no longer exist or that a static equilibrium has been achieved. Accordingly we believe that any projection that considers, explicitly yet conservatively, the relationship between land-use and land capability is preferable and considerably more appropriate than one that assumes no relationship and no change (Figure 9). We therefore recommend that the Service projection of future without project conditions contained herein be considered in any further analysis of the Yazoo Backwater Area Project.



**Figure 9. Wetland restoration trend beginning 1990-1998 and future without project projections 1999-2048 in Yazoo Backwater Area.**

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Table 3a. Distribution of wetland restoration within Zone 1 (within 2-yr floodplain 91') by soil drainage and county.

Soil drainage <sup>a</sup>	County	Restoration				
		Observed 1990-1998		Projected 1999-2049		
		Acres	OROC <sup>b</sup>	Available 1999	PROC <sup>b</sup>	Acres
MW-SP	Humphreys	0	0	42	0	0
	Issaquena	152	17	1,937	17	850
	Sharkey	148	16	1,902	15	750
	Warren <sup>c</sup>	424	47	787	31	478
	Washington	0	0	0	0	0
	Yazoo	974	108	3,960	0	0
	Subtotal	1,698	188	8,628	63	2,078
SP-P	Humphreys	14	2	175	0	0
	Issaquena	6,809	757	12,561	392	12,561
	Sharkey	146	16	1,214	16	800
	Warren <sup>c</sup>	1,496	166	2,697	126	1,969
	Washington <sup>d</sup>	1	<1	85	1	50
	Yazoo	4,419	491	1,705	0	0
	Subtotal	12,885	1,433	18,437	535	15,380
P-VP	Humphreys	7	1	6	0	0
	Issaquena	5,012	557	2,257	222	2,257
	Sharkey	12,408	1,379	10,576	1,333	10,576
	Warren <sup>c</sup>	0	0	1	0	0
	Washington <sup>d</sup>	0	0	55	<1	2
	Yazoo	0	0	438	0	0
	Subtotal	17,427	1,937	13,333	1,556	12,835
Total		32,010	3,558	40,398	2,154	30,293

<sup>a</sup> VP-very poorly, P - poorly, SP - somewhat poorly, MW - moderately well.

<sup>b</sup> Observed (OROC) and projected (PROC) annual rate of change.

<sup>c</sup> Projected acreage was adjusted to prevent exceeding 25% WRP/CRP program caps within county.

<sup>d</sup> Fish and Wildlife Service's acquisition boundaries resulted in increased PROC.

Table 3b. Distribution of wetland restoration within Zone 2 (within 2-yr &gt;91') by soil drainage and county.

Soil drainage <sup>a</sup>	County	Restoration				
		Observed 1990-1998		Projected 1999-2049		
		Acres	OROC <sup>b</sup>	Available 1999	PROC <sup>b</sup>	Acres
MW-SP	Humphreys	1	0	1,188	0	0
	Issaquena	0	0	1,283	0	0
	Sharkey	52	6	3,188	0	0
	Warren <sup>c</sup>	11	1	114	1	11
	Washington	0	0	232	0	0
	Yazoo	65	7	1,034	0	0
	Subtotal	129	14	7,039	1	11
SP-P	Humphreys	2	0	12,692	0	0
	Issaquena	74	8	3,993	6	300
	Sharkey	459	51	10,612	16	800
	Warren	11	1	496	0	0
	Washington <sup>d</sup>	148	16	5,578	35	1,750
	Yazoo	244	27	166	0	0
	Subtotal	938	103	33,537	57	2,850
P-VP	Humphreys	17	2	57	0	0
	Issaquena	222	25	4,575	25	1,250
	Sharkey	206	23	10,659	14	700
	Warren	0	0	0	0	0
	Washington <sup>d</sup>	7	<1	7,118	16	800
	Yazoo	0	0	438	0	0
	subtotal	452	51	22,847	55	2,750
Total		1,519	168	63,423	113	5,611

<sup>a</sup> VP-very poorly, P - poorly, SP - somewhat poorly, MW - moderately well.

<sup>b</sup> Observed (OROC) and projected (PROC) annual rate of change.

<sup>c</sup> Projected acreage was adjusted to prevent exceeding 25% WRP/CRP program caps within county.

<sup>d</sup> Fish and Wildlife Service's acquisition boundaries resulted in increased PROC.

Table 3c. Distribution of wetland restoration within Zone 3 (outside 2-yr floodplain) by soil drainage and county.

Soil drainage <sup>a</sup>	County	Restoration				
		Observed 1990-1998		Projected 1999-2049		
		Acres	OROC <sup>b</sup>	Available 1999	PROC <sup>b</sup>	Acres
MW-SP	Humphreys	1	0	12,245	0	0
	Issaquena	0	0	6,632	0	0
	Sharkey	138	15	26,684	0	0
	Warren <sup>c</sup>	100	11	1,392	2	36
	Washington <sup>d</sup>	0	0	688	11	550
	Yazoo	350	39	16,294	0	0
	Subtotal	589	65	63,935	13	586
SP-P	Humphreys	1,177	131	18,508	69	3,450
	Issaquena	64	7	31,953	3	150
	Sharkey	706	78	16,989	2	100
	Warren <sup>c</sup>	55	6	4,930	3	42
	Washington	40	4	10,843	3	150
	Yazoo	3,437	382	243	0	0
	Subtotal	5,479	608	83,466	80	3,892
P-VP	Humphreys	309	34	2,811	0	0
	Issaquena	122	14	13,779	12	600
	Sharkey	701	78	30,937	40	2,000
	Warren	0	0	5	0	0
	Washington <sup>d</sup>	2	<1	2,749	9	450
	Yazoo	0	0	6,212	0	0
	subtotal	1,134	127	56,493	61	3,050
Total		7,202	800	203,894	154	7,528

<sup>a</sup> VP-very poorly, P - poorly, SP - somewhat poorly, MW - moderately well.

<sup>b</sup> Observed (OROC) and projected (PROC) annual rate of change.

<sup>c</sup> Projected acreage was adjusted to prevent exceeding 25% WRP/CRP program caps within county.

<sup>d</sup> Fish and Wildlife Service's acquisition boundaries resulted in increased PROC.

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